Geometry
Mathematics
Item Specifications

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Introduction

In 2014 Missouri legislators passed House Bill 1490, mandating the development of the Missouri Learning Expectations. In April of 2016, these Missouri Learning Expectations were adopted by the State Board of Education. Groups of Missouri educators from across the state collaborated to create the documents necessary to support the implementation of these expectations.

One of the documents developed is the item specification document, which includes all Missouri grade level/course expectations arranged by domains/strands. It defines what could be measured on a variety of assessments. The document serves as the foundation of the assessment development process.

Although teachers may use this document to provide clarity to the expectations, these specifications are intended for summative, benchmark, and large-scale assessment purposes.

Components of the item specifications include:

Expectation Unwrapped breaks down a list of clearly delineated content and skills the students are expected to know and be able to do upon mastery of the Expectation.

Depth of Knowledge (DOK) Ceiling indicates the highest level of cognitive complexity that would typically be assessed on a large scale assessment. The DOK ceiling is not intended to limit the complexity one might reach in classroom instruction.

Item Format indicates the types of items used in large scale assessment. For each expectation, the item format specifies the type best suited for that particular expectation.

Text Types suggests a broad list of text types for both literary and informational expectations. This list is not intended to be all inclusive: other text types may be used in the classroom setting. The expectations were written in grade level bands; for this reason, the progression of the expectations relies upon increasing levels of quantitative and qualitative text complexities.

Content Limits/Assessment Boundaries are parameters that item writers should consider when developing a large scale assessment. For example, some expectations should not be assessed on a large scale assessment but are better suited for local assessment.

Sample stems are examples that address the specific elements of each expectation and address varying DOK levels. The sample stems provided in this document are in no way intended to limit the depth and breadth of possible item stems. The expectation should be assessed in a variety of ways.

High School Geometry

Frequently asked questions for Item Specification and Sample Stems

1. What is the purpose of the Item Specification document?
Historically, Item Specification documents are written for test item writers. In Missouri, this document was seen as a resource for not only item writers, but teachers as well. The unwrapped section should provide more detail on the meaning of the standard and the sample stems should provide example items that also help clarify the standard. In this update, the language used in the Expanded Expectations document was included to merge the two documents for easier access. In some standards a "Notes" section was added to provide additional information.

2. Why do some unwrapped sections have the same few sentences at the beginning?
For standards that have multiple parts and are listed as sub expectations, e.g., NF.C.5.b, the first part highlights the intent of that standard series. Often, these standards should be taught together as they develop a bigger idea or concept.

3. Why is the Fluency definition only on some standards?
Certainly, students having experience using different strategies and picking the strategy they feel best for given situations is important to improving student knowledge in mathematics. The Missouri Educators working on the document felt it important to highlight areas where student access to multiple strategies would provide the greatest support. Listing fluency in all standards would likely lessen the impact needed.

4. What does the "e.g." mean when listed in the unwrapped section?
The "e.g." is a way to highlight a list of examples, ideas, or concepts. It is **not** an exhaustive list, nor is it intended to represent the best examples. It is merely a partial list to provide some examples.

5. What does "with or without context" mean?
This phrase was used to highlight that the math problems might have some situational context or could possibly be a strictly number or symbol situation. The Educators working on this update wanted the focus to be on using math to solve problem situations rather than a focus on "real world" problems.

6. Are the Sample Stems examples of summative test items?
The Sample Stems could be a classroom item or possibly an assessment item. In some cases, the problem used would have to be adjusted to use on a Statewide assessment. The goal was to give students and teachers a problem that aligns to the standard. The Stems provided in the document are an example. The educators assisting with the update in some cases created more than one example and those are listed at the bottom of the document. All examples are good, some fit better on the page within the Item Specification which have determined those shown in both places.

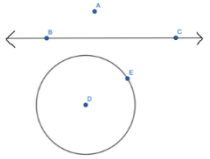
7. Why are there no answers listed with the Sample Stems?
The focus of the Sample Stems should be on the work students can demonstrate to indicate their level of understanding for the given standard. While the answer is one component, when given, it frequently becomes the focus which does not provide important information in the learning process.

8. What does "No Limits" mean in the Limits and Boundaries section?
Where there are no limits or boundaries to be listed, "No Limits" was used to indicate this situation and help those using the document understand that it wasn't an oversight. IMPORTANT NOTE: if the standard itself or the cluster heading lists a specific limit, e.g., specific denominators, size or type of number, that was not duplicated in the Limits section.

9. Why do some words show a short definition?
While this does not serve as a replacement for a glossary, there were terms within the unwrapping that the committee felt should have meaning included. This occurs in the standard where it specifically addresses the concept in the standard, e.g., cardinality, trapezoid.

10. Why are Kindergarten and Grade 1 Sample Stems a bit different?
Students in Kindergarten and Grade 1 are beginning readers, so teachers should expect to read problems to the students rather than only providing problems to be solved.

High School Geometry

Mathematics		G.CO.A.1
CO A 1	**Congruence** **Experiment with transformations in the plane.** Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will use the undefined notions (terms) of point, line, and plane to develop mathematical definitions of angle, circle, perpendicular line, parallel line, line segment and ray. The student would use distance around a circular arc as part of the definition of an angle and use the distance along a line as a part of the definition of a line segment.		**Sample Stems** Describe how an angle is related to points, lines, distance along a line, and/or distance around a circular arc.  You may want to identify an angle to assist with the description. Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 1		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.CO.A.2
CO A 2	**Congruence** **Experiment with transformations in the plane.** Represent transformations in the plane, and describe them as functions that take points in the plane as inputs and give other points as outputs.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will represent transformations in the plane, e.g., transparencies and geometry software. The student will describe transformations as functions that take points in the plane as inputs and give other points as outputs. The student will compare transformations that preserve distance and angle to those that do not, e.g., translation versus horizontal stretch. Transformations include translations, rotations, reflections, and dilations.		**Sample Stems** Plot a quadrilateral in the coordinate plane and list the coordinates of each vertex. This will be quadrilateral ABCD, used in all 3 parts. Take the opposite of each y coordinate of quadrilateral ABCD and plot the new quadrilateral. Compare and contrast the new quadrilateral with the preimage and express this transformation with function notation. Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 2		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.CO.A.3
CO A 3	**Congruence** **Experiment with transformations in the plane.** Describe the rotational symmetry and lines of symmetry of two-dimensional figures.	

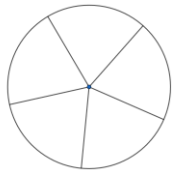
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use a given two-dimensional figure to describe the rotations and reflections that carry it onto itself.

The student will determine the number of lines of reflection symmetry and the degree of rotational symmetry of any regular polygon.

Sample Stems

The side view of a wheelbarrow wheel is shown below.



If you watched the wheelbarrow wheel as it was pushed, what would you observe about the wheel's rotation and reflection?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

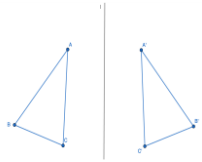
YES – a calculator will be available for items

DOK Ceiling: 2

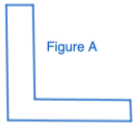
Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics	G.CO.A.4
CO A 4	**Congruence** **Experiment with transformations in the plane.** Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.	**Sample Stems**
The student will develop a definition of rotation in terms of angles and circles. The student will develop a definition of reflection in terms of perpendicular lines and line segments. The student will develop a definition of translation in terms of parallel lines and line segments.	ΔABC has been reflected across line *l* to obtain ΔA'B'C':  Sarah notices that if she connects each point to its image (A to A', B to B', C to C'), the resulting line segments will be perpendicular to line *l*. She thinks she can describe reflection in terms of line segments and perpendicular lines. What could her description look like? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.	**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3	
Item Format: Selected Response, Constructed Response, Technology Enhanced	

High School Geometry

Mathematics		G.CO.A.5
CO A 5	**Congruence** **PRIORITY STANDARD** **Experiment with transformations in the plane.** Demonstrate the ability to rotate, reflect or translate a figure, and determine a possible sequence of transformations between two congruent figures.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will use a given geometric figure and a rotation, reflection and/or translation, to draw the transformed figure using graph paper, tracing paper, or geometry software. The student will specify a sequence of transformations that will carry a given figure onto another.		**Sample Stems** Figure A is shown below:  Roll a standard 6-sided die twice. If the roll is: 1 or 2: Perform a translation on figure A 3 or 4: Perform a reflection on figure A 5 or 6: Perform a rotation on figure A Label the image A', then describe the sequence of transformations you followed. (See additional stems for further information on this stem.) Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.CO.B.6
CO **B** **6**	**Congruence** **Understand congruence in terms of rigid motions.** Develop the definition of congruence in terms of rigid motions.	**PRIORITY STANDARD**

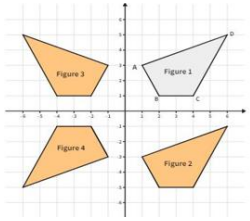
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use the descriptions of rigid motions (translations, rotations, reflections) to transform one figure (the pre-image) into another (the image) and predict the effect of a given rigid motion on a given figure, e.g., preservation of angle measure, betweenness, collinearity, and distance.

The student will use the definition of congruence in terms of rigid motions (preserving side length, size, and angle measure) to decide if two figures are congruent, e.g., Is there a combination of rigid motions that transforms the first figure onto the second?

Sample Stems

Figure 1 has been transformed into each of the other figures shown below.



First, describe what you notice about figure 1 and each of its images. What must be true about figures 2, 3, and 4?
Then, describe a sequence of transformations that would map figure 2 to figure 4.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CO.B.7
CO B 7	**Congruence** **Understand congruence in terms of rigid motions.** Develop the criteria for triangle congruence from the definition of congruence in terms of rigid motions.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. When distance is preserved, corresponding sides are congruent, and angle measure is preserved, corresponding angles are congruent, and the triangles must also be congruent. The student will explain how the criteria for triangle congruence (ASA, AAS, SAS and SSS) follow from the definition of congruence in terms of rigid motions and that they represent minimum requirements for congruence of any two triangles.		**Sample Stems** Draw two acute angles that share a common side. Then, perform any rigid motion transformation (translation, reflection, or rotation) on your figure. Next, extend the angles in both the image and preimage to create two triangles (if needed). Are the two triangles congruent? How do you know? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

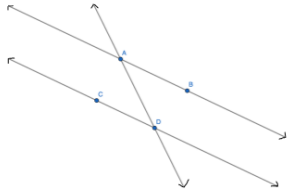
Mathematics		G.CO.C.8
CO C 8	**Congruence** **Prove geometric theorems.** Prove theorems about lines and angles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will prove theorems about lines and angles. For this expectation, theorems should include, but are not limited to, the following: vertical angles are congruent; if two lines are intersected by a transversal, and if alternate interior angles are congruent, then the two lines are parallel; points on a perpendicular bisector of a line segment are exactly those equidistant from the line segment's endpoints.

Sample Stems

In the diagram below, line AB is parallel to line CD.



Prove that $\angle BAD \cong \angle CDA$.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

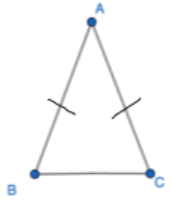
Mathematics		G.CO.C.9
CO C 9	**Congruence** **Prove geometric theorems.** Prove theorems about triangles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will prove theorems about triangles. For this expectation, theorems should include, but are not limited to, the following: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point; proving two triangles are congruent using ASA, AAS, SAS, SSS, and/or HL congruence theorems.

Sample Stems

An example of an isosceles triangle is shown, with congruent sides $\overline{AB}$ and $\overline{AC}$:



Prove that the base angles of this isosceles triangle, $\angle B$ and $\angle C$, are congruent.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

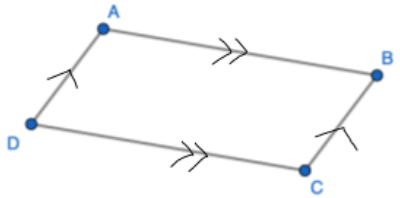
Mathematics		G.CO.C.10
CO C 10	**Congruence** **Prove geometric theorems.** Prove theorems about polygons.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will prove theorems about polygons. For this expectation, theorems should include, but are not limited to, the following: given a parallelogram opposite sides are congruent, opposite angles are congruent and the diagonals bisect each other, conversely, rectangles are parallelograms with congruent diagonals; given a kite, the diagonals are perpendicular to each other.

Sample Stems

Parallelogram ABCD is shown, where $\overline{AD} \parallel \overline{BC}$ and $\overline{AB} \parallel \overline{BC}$:



Prove that the opposite sides of parallelogram ABCD are congruent.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CO.D.11
CO D 11	**Congruence** **Make geometric constructions.** Construct geometric figures using various tools and methods.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will make formal and informal geometric constructions with a variety of tools and methods (physical or virtual compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

The student will construct basic geometric components, e.g., copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

The student will construct specific geometric shapes, e.g., regular hexagons inscribed in circles, equilateral triangles, squares, etc.

Sample Stems

Draw a line segment, $\overline{AB}$, either on paper or on a virtual tool.
Then roll a 6-sided die and construct the result:
Roll a 1 or 2) Copy $\overline{AB}$
Roll a 3 or 4) Construct the perpendicular bisector of $\overline{AB}$
Roll a 5 or 6) Construct a line segment parallel to $\overline{AB}$
Then, guide a partner to reproduce your construction, either with verbal or written instructions.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.SRT.A.1
SRT **A** **1**	**Similarity, Right Triangles, and Trigonometry** **Understand similarity in terms of similarity transformations.** Construct and analyze scale changes of geometric figures.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will verify experimentally the properties of dilations given by a center and a scale factor where a dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged.

The student will verify experimentally the properties of dilations given by a center and a scale factor where the dilation of a line segment is longer (enlargement) or shorter (reduction) in the same ratio as the scale factor.

Sample Stems

Using paper or a digital tool, draw any quadrilateral ABCD, then draw another point labeled E.

Measure each side length of quadrilateral ABCD, then dilate quadrilateral ABCD from center E by your choice of scale factor.

What do you notice about the sides of your preimage, quadrilateral ABCD, and the image?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Limit the center of dilation to the origin for those that are on the coordinate plane.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.SRT.A.2
SRT **A** **2**	**Similarity, Right Triangles, and Trigonometry** **Understand similarity in terms of similarity transformations.** Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.	

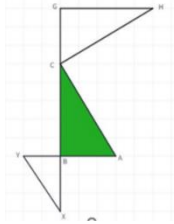
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will decide if two figures are similar by determining if there is a similarity transformation that maps one figure (the pre-image) to the other figure (the image).

The student will explain using similarity transformations the meaning of similarity for polygons as the congruence of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Sample Stems

Given the figure below, justify using transformations which triangle is similar to triangle ABC:



Then verify the relationship between the corresponding side lengths and corresponding angle measures of the similar triangles.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

Mathematics		G.SRT.A.3
SRT **A** **3**	**Similarity, Right Triangles, and Trigonometry** **Understand similarity in terms of similarity transformations.** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Sample Stems

With a partner, choose two angle measures that have a sum of less than 180º. Then, each partner should draw two angles with those measures using either physical or digital tools so that the two angles share a side, but not a vertex.

Then extend the two angles until both partners have drawn a triangle.

Measure the side lengths and angle measures of your triangle and compare the measurements to your partner's triangle.

What do you notice about the two triangles? Do you think this will always be true?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.SRT.B.4
SRT B 4	**Similarity, Right Triangles, and Trigonometry** **Prove theorems involving similarity.** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

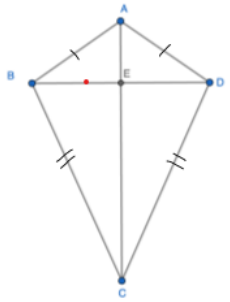
The student will solve problems with or without context using congruence and similarity.

The student will prove theorems about triangles. (Theorems should include, but not be limited to: a line parallel to one side of a triangle divides the other two sides proportionally, and conversely, prove the Pythagorean Theorem using triangle similarity.) Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

The student will prove theorems about triangle similarity that includes, but not be limited to: two pairs of corresponding angles are congruent (AA Similarity), three pairs of corresponding sides are proportional (SSS similarity), two pairs of corresponding sides are proportional and the included pair of corresponding angles are congruent (SAS similarity), two right triangles have proportional hypotenuse and legs (HL similarity).

Sample Stems

Kite ABCD is shown, where AB = AD and BC = DC:



Which triangles in the diagram are congruent? Write a proof for your congruence statement.
Are any of the triangles shown similar? Justify your response.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

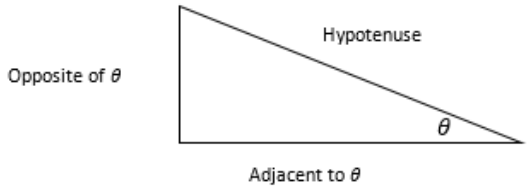
Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.SRT.C.5
SRT C 5	**Similarity, Right Triangles, and Trigonometry** **Define trigonometric ratios, solve problems involving right triangles.** Understand that side ratios in right triangles define the trigonometric ratios for acute angles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will understand that side ratios in right triangles define the trigonometric ratios (sine, cosine, tangent, secant, cosecant, cotangent) for acute angles.



$\sin of\ \theta = \sin\theta = \frac{opposite}{hypotenuse}$

$\cos ine\ of\ \theta = \cos\theta = \frac{adjacent}{hypotenuse}$

$\tan gent\ of\ \theta = \tan\theta = \frac{opposite}{adjacent}$

$cosecant\ of\ \theta = \csc\theta = \frac{hypotenuse}{opposite}$

$secant\ of\ \theta = \sec\theta = \frac{hypotenuse}{adjacent}$

$cotangent\ of\ \theta = \cot\theta = \frac{adjacent}{opposite}$

Sample Stems

Roll 2 ten-sided dice. Using either graph paper and physical tools or a digital tool, draw a right triangle ΔABC where angle B is a right angle, and the length of legs $\overline{AB}$ and $\overline{BC}$ are equal to the rolls on your dice.

Then, find the length of hypotenuse $\overline{AC}$ and list the following ratios:

$\frac{AB}{AC}$ $\frac{BC}{AC}$ $\frac{AB}{BC}$ $\frac{AC}{AB}$ $\frac{AC}{BC}$ $\frac{BC}{AB}$

Then dilate ΔABC from center A by a scale factor of your choice to obtain ΔA'B'C', then list the following ratios:

$\frac{A'B'}{A'C'}$ $\frac{B'C'}{A'C'}$ $\frac{A'B'}{B'C'}$ $\frac{A'C'}{A'B'}$ $\frac{A'C'}{B'C'}$ $\frac{B'C'}{A'B'}$

What do you notice about the corresponding ratios?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

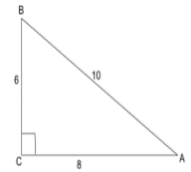
Mathematics		G.SRT.C.6
SRT C 6	**Similarity, Right Triangles, and Trigonometry** **Define trigonometric ratios, solve problems involving right triangles.** Explain and use the relationship between the sine and cosine of complementary angles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will explain and use the relationship between the sine and cosine of complementary angles, e.g., given a pair of complementary angles A and B, the sine of angle A is equal to the cosine of angle B and the cosine of angle A is equal to the sine of angle B.

Sample Stems

Use the information from the triangle to write the following trigonometric ratios:



$\sin(A) = \frac{\text{opposite}}{\text{hypotenuse}} =$

$\cos(A) = \frac{\text{adjacent}}{\text{hypotenuse}} =$

$\tan(A) = \frac{\text{opposite}}{\text{adjacent}} =$

$\sin(B) =$

$\cos(B) =$

$\tan(B) =$

What do you notice about the relationships between the trigonometric ratios of the two different reference angles in this right triangle?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

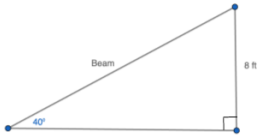
Mathematics		G.SRT.C.7
SRT C 7	**Similarity, Right Triangles, and Trigonometry** **Define trigonometric ratios, solve problems involving right triangles.** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use trigonometric ratios and the Pythagorean Theorem to solve problems with and without context that involve right triangles.

Sample Stems

A construction crew wants to hoist a heavy beam so that it is standing up straight. They tie a rope to the beam, secure the base, and pull the rope through a pulley to raise one end of the beam from the ground. When the beam makes an angle of 40 degrees with the ground, the top of the beam is 8 ft above the ground.



The construction site has some telephone wires crossing it. The workers are concerned that the beam may hit the wires. When the beam makes an angle of 60 degrees with the ground, the wires are 2 ft above the top of the beam. Will the beam clear the wires on its way to standing up straight? Explain your answer.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

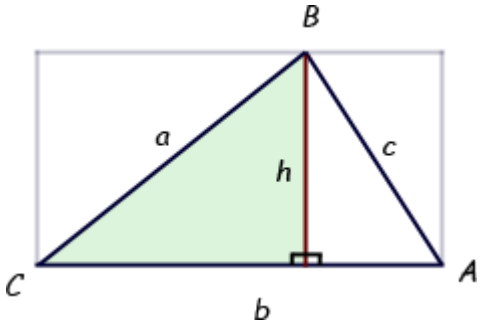
Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics	G.SRT.C.8
SRT C 8	**Similarity, Right Triangles, and Trigonometry** **Define trigonometric ratios, solve problems involving right triangles.** Derive the formula A = 1/2 ab sin(C) for the area of a triangle.

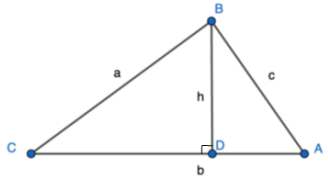
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will derive the formula A=1/2 ab sin (C) for the area of a triangle, e.g., student will explain how the area formula of triangle ABC relates to A=1/2 ab sin (C).



Sample Stems

ΔABC is shown below, with perpendicular height h.



First, write the area of ΔABC using the necessary dimensions given in the diagram.

Next, write the sine of angle C as a ratio of side lengths, then solve for h.

Finally, substitute the value of h you obtained in the previous into the formula for the area of your triangle.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

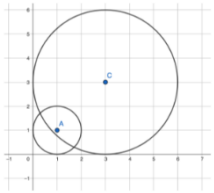
Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.C.A.1
C **A** **1**	**Circles** **Understand and apply theorems about circles** Prove that all circles are similar using similarity transformations.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will prove that all circles are similar using similarity transformations (dilations).		**Sample Stems** Two circles, one with center A and radius of 1 and another with center C and a radius of 3, are shown below.  What transformation or sequence of transformations would map one circle to the other? Based on your answer, what is the relationship between these two circles? Is it possible to create another circle where the relationship from part 2 does not apply? Why or why not? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

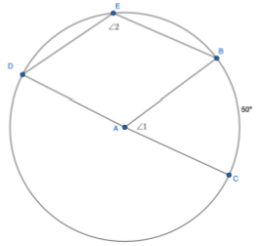
Mathematics		G.C.A.2
C **A** **2**	**Circles** **Understand and apply theorems about circles** Identify and describe relationships among inscribed angles, radii and chords of circles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will identify and describe relationships among inscribed angles, radii and chords, e.g., the relationship between central, inscribed and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

Sample Stems

Circle A, with diameter $\overline{CD}$ and $m\widehat{BC} = 50°$, is shown below.



Find $m\angle 1$ and $m\angle 2$.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.C.A.3
C **A** **3**	**Circles** **Understand and apply theorems about circles** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will construct the inscribed and circumscribed circles of a triangle. The student will prove properties of angles for a quadrilateral inscribed in a circle.		**Sample Stems** Draw any triangle, ΔABC, on paper or using digital tools. Then, construct three perpendicular bisectors, one bisecting $\overline{AB}$, one bisecting $\overline{BC}$, and one bisecting $\overline{AC}$ Label the point of intersection of the three perpendicular bisectors you just constructed as point D. What do you notice about the distances from point D to each vertex of ΔABC? Finally, construct a circle whose center is point D that passes through points A, B, and C. Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.C.B.4
C **B** **4**	**Circles** **Find arc lengths and areas of sectors of circles.** Derive the formula for the length of an arc of a circle.	

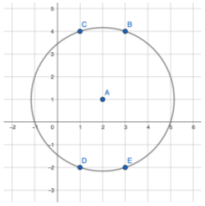
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will demonstrate or explain how the length of the arc intercepted by an angle is proportional to the radius to derive the formula for the length of an arc of a circle.

Note: both radians and degrees could be used in problems tied to this expectation.

Sample Stems

Circle A with points B, C, D, and E is shown below.



Write the equation of circle A.
Support your equation by comparing the distance formula:

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = d$$

To the general formula for a circle:

$$(x - h)^2 + (y - k)^2 = r^2$$

(See additional stems for further information on this stem.)

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

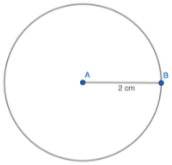
Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.C.B.5
C **B** **5**	**Circles** **Find arc lengths and areas of sectors of circles.** Derive the formula for the area of a sector of a circle.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will derive the formula for the area of a sector of a circle, e.g., by using ratios of arc lengths. Note: both radians and degrees could be used in problems tied to this expectation.		**Sample Stems** Circle A with radius 2 cm is shown:  What information would you need to calculate the length of any sector formed in circle A? How would you use this information to calculate the area of the sector? (See additional stems for further information on this stem.) Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

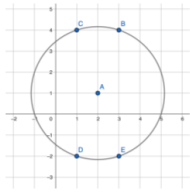
Mathematics		G.GPE.A.1
GPE **A** **1**	**Exploring Geometric Properties with Equations** **Translate between the geometric description and the equation for a conic section.** Derive the equation of a circle.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will demonstrate or explain the relationships involved with the equation of a circle, e.g., use the center and radius with the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Sample Stems

Circle A with points B, C, D, and E is shown below.



First, calculate the radius of circle A.

Then, substitute the radius you found into the distance formula:

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = d$$

How can you use the distance formula to verify the radius of the circle using a different point than the one you originally selected?

(See additional stems for further information on this stem.)

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

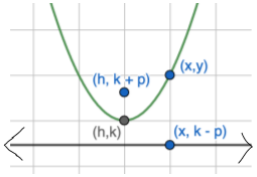
Mathematics		G.GPE.A.2
GPE **A** **2**	**Exploring Geometric Properties with Equations** **Translate between the geometric description and the equation for a conic section.** Derive the equation of a parabola given a focus and directrix.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will demonstrate or explain the relationships involved with the equation of a parabola, e.g. use the fact that the distances from any point on the parabola to a given focus and to a given directrix are equal to develop the formula $(x - h)^2 = 4p(y - k)$.

Sample Stems

A parabola is shown below, alongside other points and a line.



Use the distance formula to represent the distance from point A to the focus, (h, k + p).

Next, use the distance formula to represent the distance from point A to a point on the directrix (x, k - p).

Finally, use the fact that the distance from parts a and b are equal to generate an equivalent representation for the equation of the parabola.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

The parabola's vertex should be at the origin.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

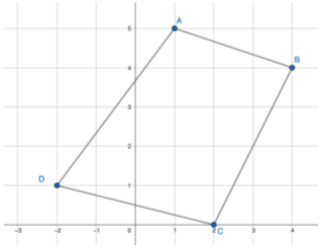
Mathematics		G.GPE.B.3
GPE **B** **3**	**Exploring Geometric Properties with Equations** **Use coordinates to prove geometric theorems algebraically.** Use coordinates to prove geometric theorems algebraically.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use coordinates to prove geometric theorems algebraically, e.g., prove or disprove that a figure defined by four given points in the Cartesian coordinate plane is a rectangle; prove or disprove that the point $(1,\sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2).

Sample Stems

Quadrilateral ABCD is shown below.



Tim claims that quadrilateral ABCD is a rhombus because all four sides look congruent. Do you agree with Tim? Explain why being sure to prove your claim using the attributes of a rhombus with any needed measurements of quadrilateral ABCD.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

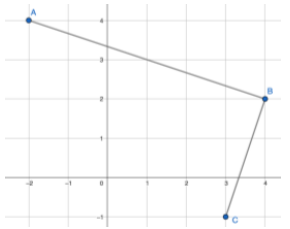
Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.GPE.B.4
GPE **B** **4**	**Exploring Geometric Properties with Equations** **Use coordinates to prove geometric theorems algebraically.** Prove the slope criteria for parallel and perpendicular lines and use them to solve problems.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point. Slope criteria includes how the slopes of parallel lines and the slopes of perpendicular lines have a particular relationship.		**Sample Stems** Three vertices of rectangle ABCD are shown below.  What are the coordinates of vertex D? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 3		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

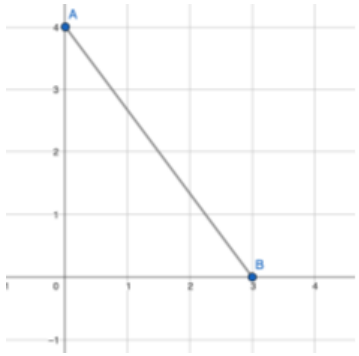
Mathematics		G.GPE.B.5
GPE **B** **5**	**Exploring Geometric Properties with Equations** **Use coordinates to prove geometric theorems algebraically.** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Sample Stems

$\overline{AB}$ is shown below.



Find the coordinates of a point C so that $AC:CB$ is a $1:3$ ratio.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Limit ratio to simple ratios of thirds or fourths.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

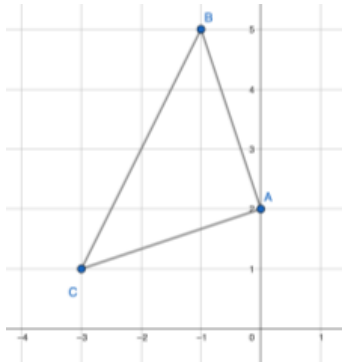
Mathematics		G.GPE.B.6
GPE **B** **6**	**Exploring Geometric Properties with Equations** **Use coordinates to prove geometric theorems algebraically.** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Sample Stems

ΔABC is shown below.



Calculate the area and the perimeter of ΔABC.
Support your solutions with words, equations, or other mathematical strategies.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.GMD.A.1
GMD **A** **1**	**Geometric Measurement and Dimension** **Explain volume formulas and use them to solve problems.** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid and cone.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone, e.g., use dissection arguments, Cavalieri's principle or informal limit arguments. The focus is on the description of the relationship between lengths, area, and volume rather than the process used to make the argument, e.g., how a scale factor change on a length will impact area or volume.

Sample Stems

Stack ten flat, circular cookies vertically. What solid does the stack of cookies form? What is the volume of this solid?

Then, carefully adjust the stack of cookies so that the top cookie is not directly above the bottom cookie. What is the volume of this solid? Did the volume change when you adjusted the stack?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.GMD.A.2
GMD A 2	**Geometric Measurement and Dimension** **Explain volume formulas and use them to solve problems.** Use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.	**PRIORITY STANDARD**

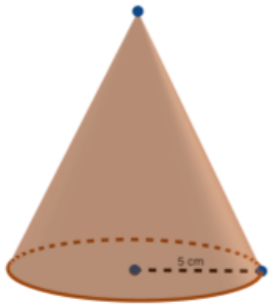
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use volume formulas for cylinders, pyramids, cones, spheres, and composite figures to solve problems with or without context.

This will include using volume formulas to model situations or to determine missing measures, e.g., slant height, altitude, height, edge length, and radius.

Sample Stems

The cone below has a radius of 5 cm and a volume of 120 cubic cm.



What is the slant height of the cone?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.GMD.B.3
GMD **B** **3**	**Geometric Measurement and Dimension** **Visualize relationships between two-dimensional and three-dimensional objects.** Identify the shapes of two-dimensional cross-sections of three-dimensional objects.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will identify or describe the shapes of two-dimensional cross-sections of three-dimensional objects. Example situations include discussing the shape of a cross-section parallel to the base of a cylinder, or the shape of an oblique cross-section not intersecting the base of a cube.

Note: the student should identify cross-sectional shapes they have experienced through Geometry and describe other possible shapes, e.g., ellipses, which they may not have studied yet.

Sample Stems

Use a piece of thin string to cut cylindrical marshmallows in different ways. Draw the two-dimensions cross sections you create by cutting the marshmallow in this way. Create as many different cross sections as you can.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.GMD.B.4
GMD **B** **4**	**Geometric Measurement and Dimension** **Visualize relationships between two-dimensional and three-dimensional objects.** Identify three-dimensional objects generated by transformations of two-dimensional objects.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will identify three-dimensional objects generated by transformations of two-dimensional objects, e.g. rotating a triangle around an axis.		**Sample Stems** Tape a standard index card to the top of a pencil (so that it resembles a small flag). Then, rapidly rotate the pencil while holding it still so that the notecard rotates around the pencil. As the notecard rotates, what three dimensional solid would be formed in the space that the notecard moves through? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension Limit the location of two-dimensional shapes to at least one side coinciding with an axis.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 2		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

Mathematics		G.MG.A.1
MG A 1	**Modeling with Geometry** **Apply geometric concepts in modeling situations.** Use geometric shapes, their measures and their properties to describe objects.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use geometric shapes, their measures and their properties to describe objects, e.g., identifying shapes to model a tree trunk or a human torso, or shapes to model the volume of a water tower.

Sample Stems

Use geometric shapes to describe how to find the volume the water tower shown below could hold.

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.MG.A.2
MG A 2	**Modeling with Geometry** **Apply geometric concepts in modeling situations.** Apply concepts of density based on area and volume in modeling situations.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will apply concepts of density based on area and volume in modeling situations, e.g., persons per square mile, BTUs per cubic foot.		**Sample Stems** An umbrella in the shape of a cone is open during a snowstorm. The umbrella has a base radius of 4 feet and a height of 1 foot. Snow accumulates on top of the umbrella evenly, to a depth of 5 inches and weighs 5 pounds. What is the volume of snow on top of the umbrella? (Remember that p=m/V, where p = density, m = mass, v = volume) Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension Give formula for density in the prompt.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 2		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.MG.A.3
MG A 3	**Modeling with Geometry** **Apply geometric concepts in modeling situations.** Apply geometric methods to solve design mathematical modeling problems.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will apply geometric methods to solve design mathematical modeling problems, e.g., design an object or structure to satisfy physical constraints or minimize cost, calculate how many boxes a truck can hold.

Mathematical Fluency is more than a quick answer on a timed test. Students demonstrate Fluency when they do mathematics using an ***appropriate strategy*** in a reasonable amount of time, ***knowing multiple processes*** and can apply or adapt strategies to find a correct solution.

The student will use and explain multiple strategies to solve problems with or without context using design mathematical modeling by applying geometric methods.

Sample Stems

Below is a model of a silo built to hold grain.

The silo's base has a diameter of 200 feet. The cylinder reaches a height of 150 feet before attaching to the half sphere top.

In cubic feet, what is the volume of this silo and what would be its surface area?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

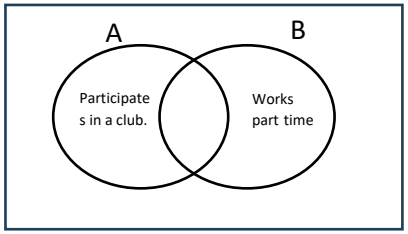
Mathematics		G.CP.A.1
CP **A** **1**	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will describe events as subsets of a sample space (the set of possible outcomes) using characteristics (or categories) of the outcomes. Descriptions could also include the results from unions, intersections or complements of other events ("or", "and", "not").

Sample Stems

A Venn diagram of events related to students at a high school is shown below.



Use the following characteristics of outcomes to describe each event.

A∪B

A∩B

(A∪B)

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CP.A.2
CP A 2	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Understand the definition of independent events and use it to solve problems.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will solve problems with or without context and demonstrate an understanding that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities and use this characterization to determine if they are independent.

Sample Stems

The table below shows some of the results of a survey given to 3rd and 4th grade students about their favorite ice cream flavors. The students were asked which flavor they preferred between strawberry and chocolate, and some of the numbers of students who preferred each are shown:

	Strawberry	*Chocolate*	*Total*
3rd Grade		24	
4th Grade	10	30	40

If a student's grade level and ice cream preference are independent, how many 3rd grade students preferred strawberry ice cream?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

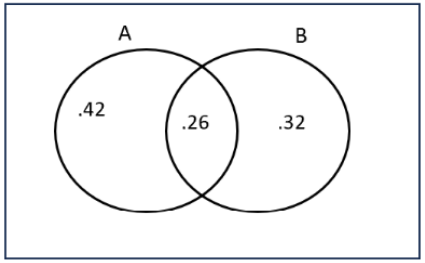
Mathematics		G.CP.A.3
CP A 3	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Calculate conditional probabilities of events.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will understand the conditional probability of A given B as $\boldsymbol{P(A|B)} = \frac{\boldsymbol{P(A \text{ and } B)}}{\boldsymbol{P(B)}}$. Calculate independence of A and B as saying that the conditional probability of A given B is the same as the probability of A and the conditional probability of B given A is the same as the probability of B.

Sample Stems

A Venn diagram of events A and B and their probabilities is shown below:



Find and interpret P(A | B)

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CP.A.4
CP A 4	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to calculate conditional probabilities.

One example would be to have a class collect data from a random sample of students in your school on their favorite subject among math, science and English, then calculate the probability that a randomly selected student from your school will favor science given that the student is from a given grade.

For Geometry, students should understand that events are independent if the conditional relative frequencies are nearly equal for all categories, since there may be no association between the variables.

Sample Stems

The table below shows some of the results of a survey given to 3rd and 4th grade students about their favorite ice cream flavors. The students were asked which flavor they preferred between strawberry and chocolate, and the numbers of students who preferred each are shown:

	Strawberry	*Chocolate*	*Total*
3rd Grade	18	32	50
4th Grade	12	38	50
Total	30	70	100

If a randomly chosen student prefers chocolate ice cream, what is the probability that this student is in 3rd grade?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CP.A.5
CP A 5	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Recognize and explain the concepts of conditional probability and independence in a context.	**PRIORITY STANDARD**

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will recognize and explain the concepts of conditional probability and independence, e.g., compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.

As an example, students will interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A and the conditional probability of B given A is the same as the probability of B. Interpret the answer in terms of the model for problems with or without context.

Sample Stems

A student is playing a game that involves them flipping a coin and then rolling a 6-sided die. Let A represent the event of the coin landing on heads and B represent the event of rolling a 6.

Sarah concludes that A and B are independent events. What does this mean in context of events A and B?

Raul concludes that $P(A|B)=1/6$. What does this mean in context of events A and B?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 3

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CP.A.6
CP A 6	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Apply and interpret the Addition Rule for calculating probabilities.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

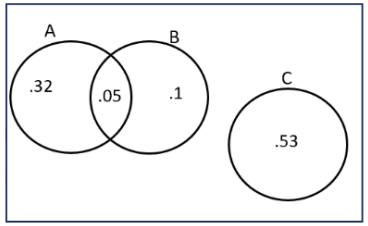
The student will apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model for problems with or without context.

For Geometry, the Addition Rule is when if A and B are two events in a probability experiment, then the probability that either one of the events will occur is: P(A or B)=P(A)+P(B)−P(A and B)

If A and B are two mutually exclusive events, P(A∩B)=0. Then the probability that either one of the events will occur is: P(A or B)=P(A)+P(B)

Sample Stems

An item is randomly selected from a basket of food. Let event A represent a fruit being selected, event B represent a red item being selected and event C represent a vegetable being selected. The sample space of these three events is shown below:



Find and interpret P(A or C).

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

Calculator Designation

YES – a calculator will be available for items

DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

High School Geometry

Mathematics		G.CP.A.7
CP A 7	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Apply and Interpret the general Multiplication Rule in a uniform probability model.	
Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations. The student will apply and interpret the general Multiplication Rule in a uniform probability model. For Geometry, the Multiplication Rule is when A and B are dependent events, then the probability of both events occurring simultaneously is given by: $\boldsymbol{P(A \cap B) = P(B) \cdot P(A|B)}$, or when A and B are two independent events in an experiment, then the probability of both events occurring simultaneously is given by: $\boldsymbol{P(A \cap B) = P(A) \cdot P(B)}$.		**Sample Stems** A population of 1000 people undergo a genetic test for a particular gene. The test for the genetic marker has a 1% false negative rate (that is, if they test negative, there's a 1% chance they carry the gene) and a 6% false positive rate (if they test positive, there is a 6% chance they don't carry the gene). If 20% of the population of 1000 people test positive for the genetic marker, approximately how many people have the gene? Additional Stems for Geometry Found at End of Document.
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension No Limits.		**Calculator Designation** **YES** – a calculator will be available for items
DOK Ceiling: 2		
Item Format: Selected Response, Constructed Response, Technology Enhanced		

High School Geometry

Mathematics		G.CP.A.8
CP A 8	**Conditional Probability and Rules of Probability** **Understand independence and conditional probability and use them to interpret data.** Use permutations and combinations to solve problems.	

Expectation Unwrapped – the intent of this section is to describe the elements of the expectation, but are NOT additional standards or expectations.

The student will use permutations, P(n,r) = $\frac{n!}{(n-r)!}$, and combinations, C(n,r) = $\frac{n!}{(n-r)!r!}$, to solve problems with or without context.

Sample Stems

A class of 12th grade students has been chosen to help their school with the fall concert. In a class of 25 students, 3 will be randomly selected to form the committee. There are two ways being considered to make the committee.

One way to form the committee is to have three roles: a planner, a treasurer, and a setup manager. How many different options are there for this committee?

The other way to form the committee is for each of the three students to have the same role. How many different options are there for this committee?

Additional Stems for Geometry Found at End of Document.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

No Limits.

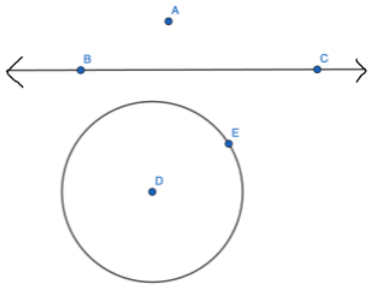
Calculator Designation

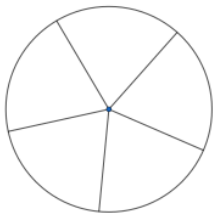
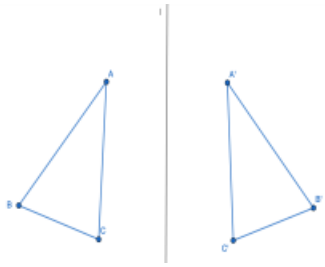
YES – a calculator will be available for items

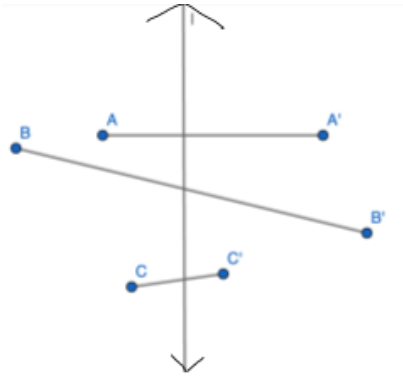
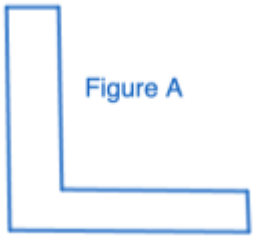
DOK Ceiling: 2

Item Format: Selected Response, Constructed Response, Technology Enhanced

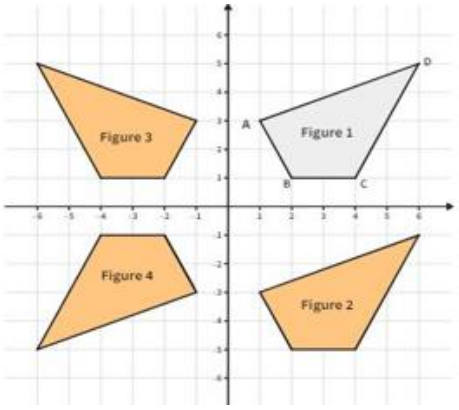
High School Geometry

Code	Sample Stem	Explanation
G.CO.A.1	Describe how an angle is related to points, lines, distance along a line, and/or distance around a circular arc.  You may want to identify an angle to assist with the description.	NOTE: This problem is still a work in progress This should be done either with physical objects (such as cutouts of a point and line) or using virtual manipulatives (such as Geogebra). Student approaches might include a verbal description, labeled parts of a diagram, and/or a demonstration showing the relationships between the objects, or other approaches.
G.CO.A.2	Plot a quadrilateral in the coordinate plane and list the coordinates of each vertex. This will be quadrilateral ABCD, used in all 3 parts. Add 2 to each x-coordinate of quadrilateral ABCD and plot the new quadrilateral. Compare and contrast the new quadrilateral with the preimage and express this transformation with function notation.	The purpose of this series of problems is to use tools (which can include graph paper, online tools, or other manipulatives) to explore transformations' effects on figures. For this part, comparisons should include preservation of side length and angle measure (ie, congruence), and differences should include location (and orientation in the case of B). For A, function notation would be f(x,y)->f(x+2,y)
	Plot a quadrilateral in the coordinate plane and list the coordinates of each vertex. This will be quadrilateral ABCD, used in all 3 parts. Take the opposite of each y coordinate of quadrilateral ABCD and plot the new quadrilateral. Compare and contrast the new quadrilateral with the preimage and express this transformation with function notation.	The purpose of this series of problems is to use tools (which can include graph paper, online tools, or other manipulatives) to explore transformations' effects on figures. For this part, comparisons should include preservation of side length and angle measure (ie, congruence), and differences should include location (and orientation in the case of B). For A, function notation would be f(x,y)->f(x+2,y) Also for this part, function notation would be f(x,y)->f(x,-y)
	Plot a quadrilateral in the coordinate plane and list the coordinates of each vertex. This will be quadrilateral ABCD, used in all 3 parts.	The purpose of this series of problems is to use tools (which can include graph paper, online tools, or other manipulatives) to explore transformations' effects on figures.

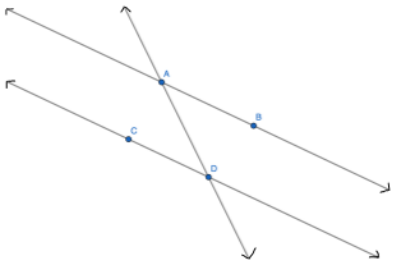
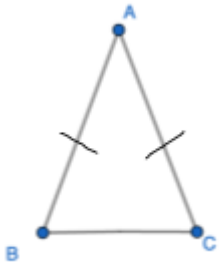
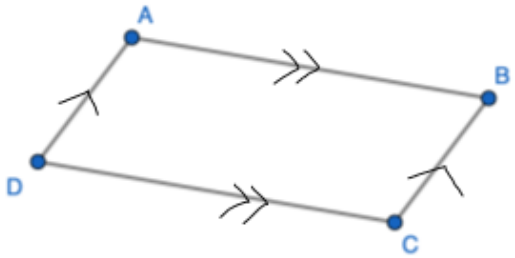
	Multiply each x and y coordinate of quadrilateral ABCD by $\frac{1}{2}$. Compare and contrast the new quadrilateral with the preimage and express this transformation with function notation.	For this part, comparisons should include preservation of angle measure, while the side lengths are different, but proportional.
Code	Sample Stem	Explanation
G.CO.A.3	The side view of a wheelbarrow wheel is shown below.  If you watched the wheelbarrow wheel as it was pushed, what would you observe about the wheel's rotation and reflection?	The purpose of this question is to explore rotational symmetry.
	ΔABC has been reflected across line *l* to obtain ΔA'B'C':  Sarah notices that if she connects each point to its image (A to A', B to B', C to C'), the resulting line segments will be perpendicular to line *l*. She thinks she can describe reflection in terms of line segments and perpendicular lines. What could her description look like?	The purpose of this problem is to expand upon the more informal definition of reflection from grade 8. Encourage students to use virtual or physical tools to manipulate the triangles to further explore the connection between the line of reflection and the line segment connecting each point to its image.
G.CO.A.4	Using a geometry tool, create three line segments $\overline{AA'}$, $\overline{BB'}$, and $\overline{CC'}$, each divided by line l (one possible example is shown below).	The purpose of this problem is to expand upon the more informal definition of reflection from grade 8. Encourage

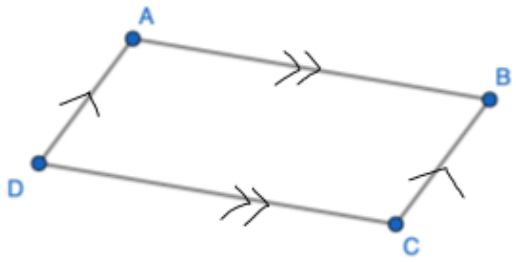
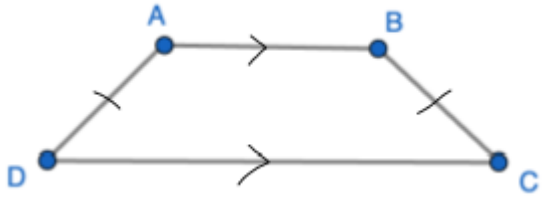
	 Arrange the three line segments so that ΔA'B'C' is a reflection of ΔABC across line l. What do you notice about the line segments and line l?	students to use virtual or physical tools to manipulate the triangles to further explore the connection between the line of reflection and the line segment connecting each point to its image.
Code	Sample Stem	Explanation
G.CO.A.5	Figure A is shown below:  Roll a standard 6-sided die twice. If the roll is: 1 or 2: Perform a translation on figure A 3 or 4: Perform a reflection on figure A 5 or 6: Perform a rotation on figure A Label the image A', then describe the sequence of transformations you followed. Then trade your figures A and A' with a partner's figures and describe the sequence of transformations that would map their figure to their image.	The purpose of this question is to explore rigid motions through technology or physical manipulatives (such as transparency paper).

High School Geometry

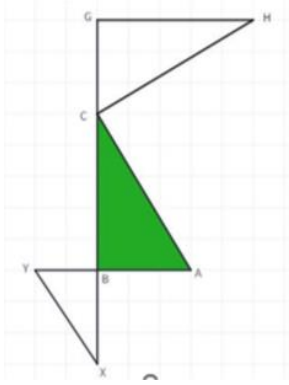
Code	Sample Stem	Explanation
G.CO.B.6	Figure 1 has been transformed into each of the other figures shown below.  First, describe what you notice about figure 1 and each of its images. What must be true about figures 2, 3, and 4? Then, describe a sequence of transformations that would map figure 2 to figure 4.	The purpose of this question is to continue to expand upon the explorations the student began in grade 8 on congruence in terms of rigid motions.
G.CO.B.7	Draw two different line segments, $\overline{AB}$ and $\overline{BC}$, meeting at point B. Name the resulting angle $\angle ABC$. Then perform any rigid motion transformation (translation, reflection, or rotation) on $\angle ABC$. Label the image $\angle A'B'C'$. Next, connect point A to C, and connect point A' to C', to create ΔABC and ΔA'B'C'. Are the two triangles congruent? How do you know?	The purpose of this question is to explore the use of rigid motions to establish SAS criteria for triangle congruence using either virtual or physical manipulatives. After students do this, facilitate a conversation regarding how the triangles must be congruent, despite starting off with only two pairs of congruent sides and the angle they form.
	Draw two acute angles that share a common side. Then perform any rigid motion transformation (translation, reflection, or rotation) on your figure. Next, extend the angles in both the image and preimage to create two triangles (if needed). Are the two triangles congruent? How do you know?	The purpose of this question is to explore the use of rigid motions to establish ASA criteria for triangle congruence using either virtual or physical manipulatives. After students do this, facilitate a conversation regarding how the triangles must be congruent, despite starting off with only two congruent pairs of angles and the common side.

High School Geometry

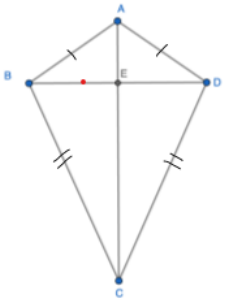
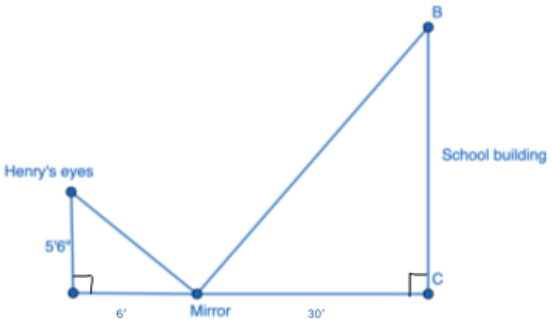
Code	Sample Stem	Explanation
G.CO.C.8	In the diagram below, line AB is parallel to line CD.  Prove that $\angle BAD \cong \angle CDA$	While students already explored the angle relationships formed by parallel lines cut by a transversal, one of the expectations in Geometry is to construct a formal proof of these relationships. Note that you can change the angles in the prompt to address other angle pairs.
G.CO.C.9	An example of an isosceles triangle is shown, with congruent sides $\overline{AB}$ and $\overline{AC}$:  Prove that the base angles of this isosceles triangle, $\angle B$ and $\angle C$, are congruent.	
G.CO.C.10	Parallelogram ABCD is shown, where $\overline{AD} \parallel \overline{BC}$ and $\overline{AB} \parallel \overline{BC}$:  Prove that the opposite sides of parallelogram ABCD are congruent.	

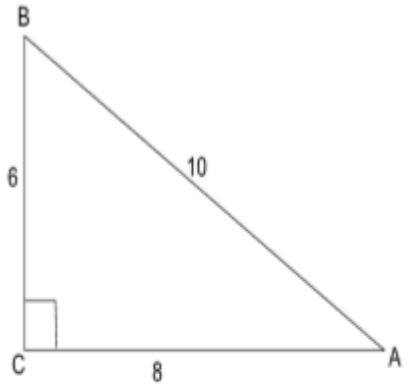
	Parallelogram ABCD is shown, where $\overline{AD} \parallel \overline{BC}$ and $\overline{AB} \parallel \overline{BC}$:  Prove that the opposite angles of parallelogram ABCD are congruent.	
	Isosceles trapezoid ABCD, with parallel sides $\overline{AB}$ and $\overline{CD}$ and congruent sides $\overline{AD}$ and $\overline{BC}$ is shown:  Prove that the base angles of isosceles trapezoid ABCD, $\angle C$ and $\angle D$, are congruent.	
Code	Sample Stem	Explanation
G.CO.D.11	Draw a line segment, $\overline{AB}$, either on paper or on a virtual tool. Then roll a 6-sided die and construct the result: Roll a 1 or 2) Copy $\overline{AB}$ Roll a 3 or 4) Construct the perpendicular bisector of $\overline{AB}$ Roll a 5 or 6) Construct a line segment parallel to $\overline{AB}$ Then, guide a partner to reproduce your construction, either with verbal or written instructions.	Students can use a variety of tools and methods to perform their formal construction, not just a straightedge and compass.
	Draw a line segment, $\overline{AB}$, either on paper or on a virtual tool. Then, construct a square whose side lengths are equal to AB. Finally, find a partner who used a different tool than you did to construct their square, and guide that partner to reproduce your construction, either with verbal or written instructions.	Students can use a variety of tools and methods to perform their formal construction, not just a straightedge and compass.

High School Geometry

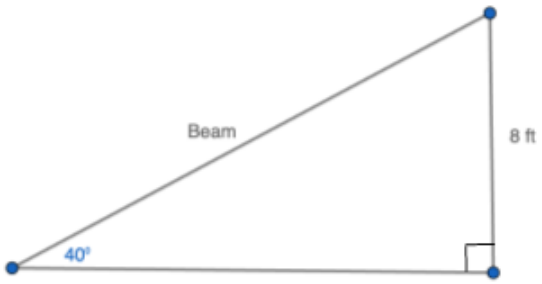
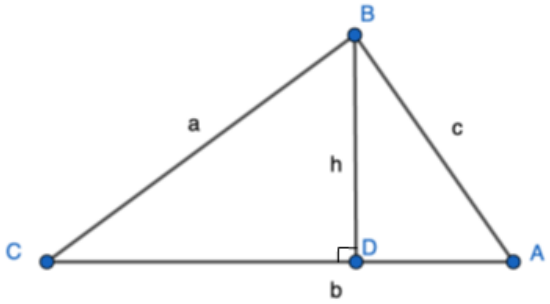
Code	Sample Stem	Explanation
G.SRT.A.1	Using paper or a digital tool, draw any quadrilateral ABCD, then draw another point labeled E. Measure each side length of quadrilateral ABCD, then dilate quadrilateral ABCD from center E by your choice of scale factor. What do you notice about the sides of your preimage, quadrilateral ABCD, and the image?	Once each student has completed their quadrilateral and dilation, facilitate a conversation for the side comparisons.
G.SRT.A.2	Given the figure below, justify using transformations which triangle is similar to triangle ABC:  Then verify the relationship between the corresponding side lengths and corresponding angle measures of the similar triangles.	
G.SRT.A.3	With a partner, choose two angle measures that have a sum of less than 180º. Then, each partner should draw two angles with those measures using either physical or digital tools so that the two angles share a side, but not a vertex. Then extend the two angles until both partners have drawn a triangle. Measure the side lengths and angle measures of your triangle and compare the measurements to your partner's triangle. What do you notice about the two triangles? Do you think this will always be true?	The purpose of this exploration is to establish the Angle-Angle criteria for triangle congruence.

High School Geometry

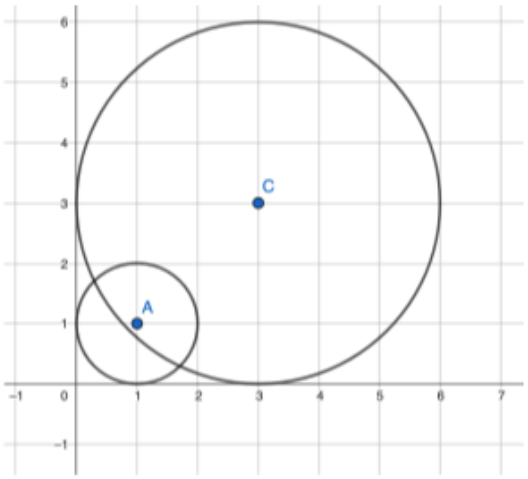
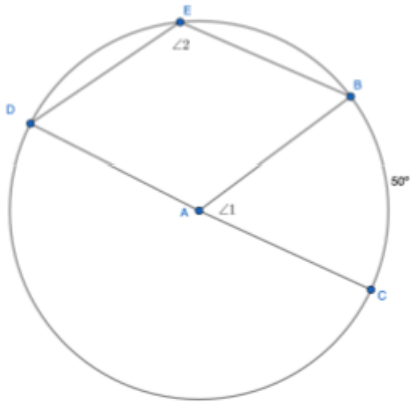
Code	Sample Stem	Explanation
G.SRT.B.4	Kite ABCD is shown, where AB = AD and BC = DC:  Which triangles in the diagram are congruent? Write a proof for your congruence statement. Are any of the triangles shown similar? Justify your response.	Note that ΔABC, ΔADC, ΔABD, and ΔCBD are also triangles in the diagram
	Henry is trying to determine the height of his school building. To do so, he places a mirror on the ground and positions himself so that he can see the top of the building in the mirror. He measures the distance between him and the mirror, and the distance between the mirror and the building. Henry then draws the following diagram with the measurements he made.  Find the height of the school building and justify your answer.	Note that this problem can be explored by students instead – use mirrors, tape measures, and justify similar triangles to find the height of a tall object (such as a building or a tree).
G.SRT.C.5	Roll 2 ten-sided dice. Using either graph paper and physical tools or a digital tool, draw a right triangle ΔABC where angle B is a right angle, and the length of legs $\overline{AB}$ and $\overline{BC}$ are equal to the rolls on your dice. Then, find the length of hypotenuse $\overline{AC}$ and list the following ratios: $\frac{AB}{AC}$ $\frac{BC}{AC}$ $\frac{AB}{BC}$ $\frac{AC}{AB}$ $\frac{AC}{BC}$ $\frac{BC}{AB}$	The purpose of this exploration is to discover how the trigonometric ratios are a consequence of dilation of a right triangle. During the conversation that occurs after the conversation, formalize the language of sine, cosine, tangent, cosecant, secant, and cotangent of an angle.

	Then dilate ΔABC from center A by a scale factor of your choice to obtain ΔA'B'C', then list the following ratios: $\frac{A'B'}{A'C'}$ $\frac{B'C'}{A'C'}$ $\frac{A'B'}{B'C'}$ $\frac{A'C'}{A'B'}$ $\frac{A'C'}{B'C'}$ $\frac{B'C'}{A'B'}$ What do you notice about the corresponding ratios?	
Code	Sample Stem	Explanation
G.SRT.C.6	Use the information from the triangle to write the following trigonometric ratios:  $sin(A) = \frac{opposite}{hypotenuse} =$ $cos(A) = \frac{adjacent}{hypotenuse} =$ $tan(A) = \frac{opposite}{adjacent} =$ $sin(B) =$ $cos(B) =$ $tan(B) =$ What do you notice about the relationships between the trigonometric ratios of the two different reference angles in this right triangle? Given a right triangle with the following trigonometric ratio: sin (40) =?	Another option is to randomly select Pythagorean triples for each student and have them carry out this same exploration to notice the relationship between the sine of an angle and the cosine of its complement.

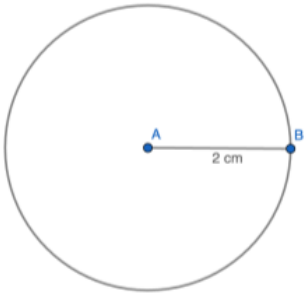
High School Geometry

Code	Sample Stem	Explanation
G.SRT.C.7	A construction crew wants to hoist a heavy beam so that it is standing up straight. They tie a rope to the beam, secure the base, and pull the rope through a pulley to raise one end of the beam from the ground. When the beam makes an angle of 40 degrees with the ground, the top of the beam is 8 ft above the ground.  The construction site has some telephone wires crossing it. The workers are concerned that the beam may hit the wires. When the beam makes an angle of 60 degrees with the ground, the wires are 2 ft above the top of the beam. Will the beam clear the wires on its way to standing up straight? Explain your answer.	
G.SRT.C.8	ΔABC is shown below, with perpendicular height h.  First, write the area of ΔABC using the necessary dimensions given in the diagram. Next, write the sine of angle C as a ratio of side lengths, then solve for h. Finally, substitute the value of h you obtained in the previous into the formula for the area of your triangle.	

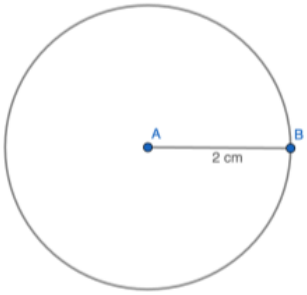
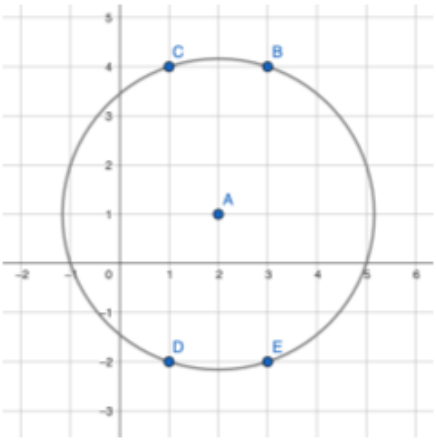
High School Geometry

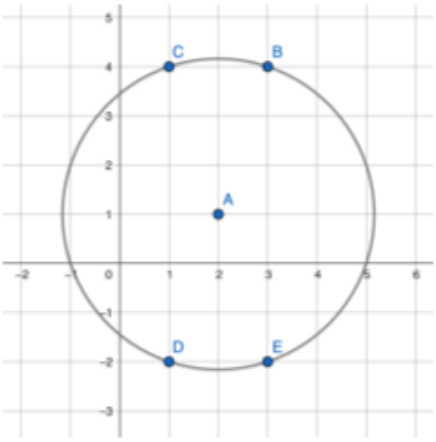
Code	Sample Stem	Explanation
G.C.A.1	Two circles, one with center A and radius of 1 and another with center C and a radius of 3, are shown below.  What transformation or sequence of transformations would map one circle to the other? Based on your answer, what is the relationship between these two circles? Is it possible to create another circle where the relationship from part 2 does not apply? Why or why not?	
G.C.A.2	Circle A, with diameter $\overline{CD}$ and $m\widehat{BC} = 50°$, is shown below.  Find $m\angle 1$ and $m\angle 2$	

High School Geometry

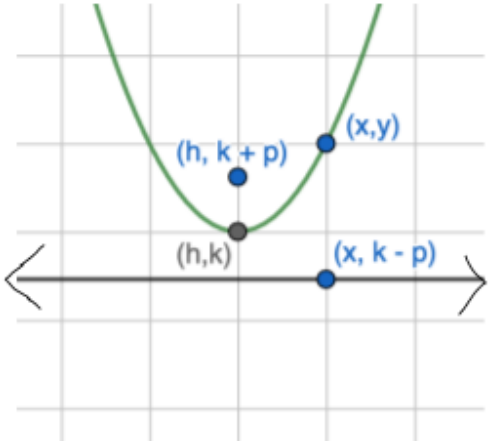
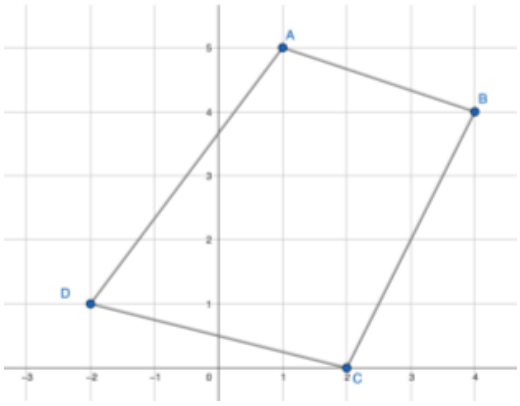
Code	Sample Stem	Explanation
G.C.A.3	Draw any triangle, ΔABC, on paper or using digital tools. Then construct three perpendicular bisectors, one bisecting $\overline{AB}$, one bisecting $\overline{BC}$, and one bisecting $\overline{AC}$ Label the point of intersection of the three perpendicular bisectors you just constructed as point D. What do you notice about the distances from point D to each vertex of ΔABC? Finally, construct a circle whose center is point D that passes through points A, B, and C.	This exploration will construct the circle circumscribed around ΔABC.
G.C.B.4	Circle A with radius 2 cm is shown:  What information would you need to calculate the length of any arc along circle A? How would you use this information to calculate the length of the arc? Concepts or ideas that could be used to support your work to answer this question include: • identifying the circumference of circle A • exploring rotating point B 180º counterclockwise about point A and label the resulting point C to find the length of arc BC. • exploring rotating point B 90º counterclockwise about point A and label the resulting point D to find the length of arc BD.	This exercise is meant to help students discover the formula for the arc length of a circle as a fraction of a circle's circumference. Support students in comparing others' justifications and how they compare to formalized formula. $s = \frac{\theta}{360}(2\pi r)$

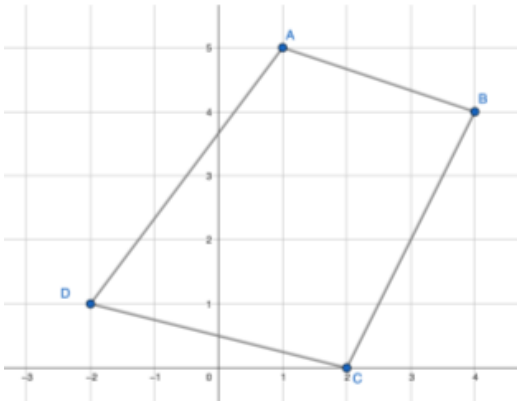
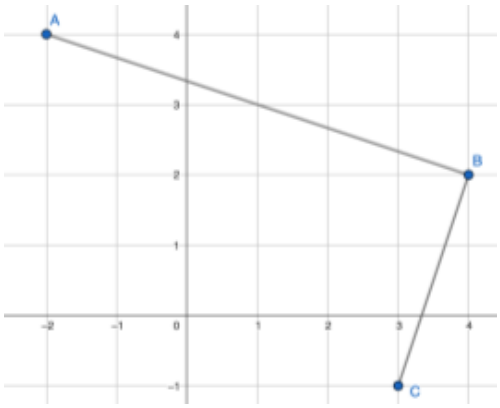
High School Geometry

Code	Sample Stem	Explanation
G.C.B.5	Circle A with radius 2 cm is shown:  What information would you need to calculate the length of any sector formed in circle A? How would you use this information to calculate the area of the sector? Concepts or ideas that could be used to support your work to answer this question include: • identifying the area of circle A • exploring rotating point B 180º counterclockwise about point A and label the resulting point C to find the area of the sector bound by arc BC. • exploring rotating point B 90º counterclockwise about point A and label the resulting point D to find area of the sector bounded by arc BD.	This exercise is meant to help students discover the formula for the sector area of a circle as a fraction of a circle's area. Support students in comparing others' justifications and how they compare to formalized formula. $s = \frac{\theta}{360}(\pi r^2)$
G.GPE.A.1	Circle A with points B, C, D, and E is shown below.  Write the equation of circle A. Support your equation by comparing the distance formula: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = d$ To the general formula for a circle:	Note that you can change the activity to focus on the Pythagorean Theorem instead of the distance formula. The purpose of this exercise is for students to verify, through exploration, the equation of a circle and identify its relationship to the distance formula or the Pythagorean Theorem.

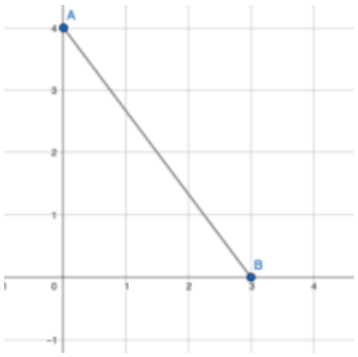
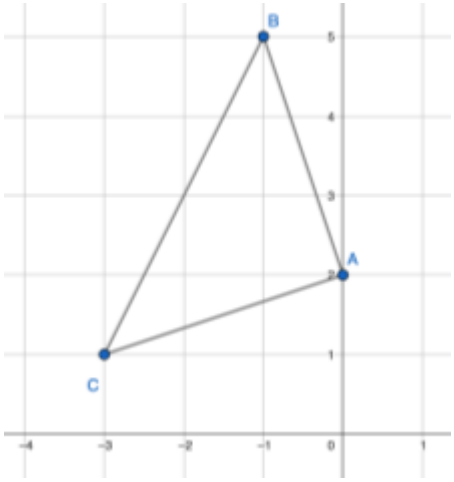
	$(x-h)^2+(y-k)^2=r^2$ Concepts or ideas that could be used to support your work to answer this question include: • Using the distance formula to verify the radius of the circle using any point on the circle. • Identify which parameters of the distance formula are changing or staying the same. • How do these parameters in the distance formula relate to those in the formula for a circle.	
Code	Sample Stem	Explanation
G.GPE.A.1	Circle A with points B, C, D, and E is shown below.  First, calculate the radius of circle A. Then, substitute the radius you found into the distance formula: $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}=d$ Then answer the following questions: Describe how to use the distance formula to verify the radius of the circle using a different point than the one originally selected. Which parameters of the distance formula are changing? Which ones are staying the same? What do these parameters correspond to? Describe how to use these findings to write the equation of any circle?	Note that you can change the activity to focus on the Pythagorean Theorem instead of the distance formula. The purpose of this exercise is for students to verify, through exploration, the equation of a circle and identify its relationship to the distance formula or the Pythagorean Theorem.

High School Geometry

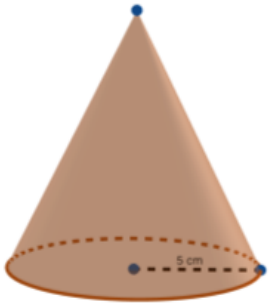
Code	Sample Stem	Explanation
G.GPE.A.2	A parabola is shown below, alongside other points and a line.  Use the distance formula to represent the distance from point A to the focus (h, k + p). Next, use the distance formula to represent the distance from point A to a point on the directrix (x, k - p). Finally, use the fact that the distance from parts a and b are equal to generate an equivalent representation for the equation of the parabola.	
G.GPE.B.3	Quadrilateral ABCD is shown below.  Harry claims that quadrilateral ABCD is a parallelogram because it looks like it has two pairs of parallel sides. Do you agree with Harry? Explain why being sure to prove your claim using the attributes of a parallelogram with any needed measurements of quadrilateral ABCD.	

	Quadrilateral ABCD is shown below.  Tim claims that quadrilateral ABCD is a rhombus because all four sides look congruent. Do you agree with Tim? Explain why being sure to prove your claim using the attributes of a rhombus with any needed measurements of quadrilateral ABCD.	
Code	Sample Stem	Explanation
G.GPE.B.4	Three vertices of rectangle ABCD are shown below.  What are the coordinates of vertex D?	

High School Geometry

Code	Sample Stem	Explanation
G.GPE.B.5	$\overline{AB}$ is shown below.  Find the coordinates of a point C so that $AC:CB$ is a $1:3$ ratio.	
G.GPE.B.6	ΔABC is shown below.  Calculate the area and the perimeter of ΔABC. Support your solutions with equations, words, or other mathematical strategies.	

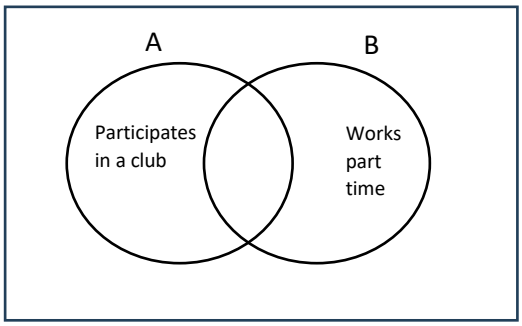
High School Geometry

Code	Sample Stem	Explanation
G.GMD.A.1	Label the center of the circle provided and cut the paper circle into four equal sectors. Note your circle's diameter and circumference. Then, arrange the four sectors so that they're next to each other, with the center of the circle pointing up and down, alternating for each sector. Does this form a familiar shape? Next, cut each of your four sectors in half so you have eight equal sectors, then arrange the eight sectors so that they're next to each other, with the center of the circle pointing up and down, alternating for each sector. What do you notice about the resulting figure? Find this figure's length, height, and area.	Provide circles of different diameters, e.g., 6-inch, 8-inch, 10-inch for students to use. This exploration is meant to show an informal argument for the area of a circle by forming a parallelogram using the relationship between the parallelogram's base and the circle's circumference.
	Stack ten flat, circular cookies vertically. What solid does the stack of cookies form? What is the volume of this solid? Then, carefully adjust the stack of cookies so that the top cookie is not directly above the bottom cookie. What is the volume of this solid? Did the volume change when you adjusted the stack?	Note: You can use any flat stackable circular objects for this exploration. The goal is to explore the volume of a non-right cylinder using Cavalieri's Principle (the flat stackable objects are the cross sections of the cylinder, and because each object has the same cross-sectional area when they're moved, the volume of the stack will remain the same).
G.GMD.A.2	The cone below has a radius of 5 cm and a volume of 120 cubic cm.  What is the slant height of the cone?	

High School Geometry

Code	Sample Stem	Explanation
G.GMD.B.3	Use a piece of thin string to cut cylindrical marshmallows in different ways. Draw the two-dimensions cross sections you create by cutting the marshmallow in this way. Create as many different cross sections as you can.	Note that you can adjust the manipulatives to suit your needs (e.g., you can use a block of tofu to explore cross sections of rectangular prisms, or use plastic utensils instead of a thin string)
G.GMD.B.4	Tape a standard index card to the top of a pencil (so that it resembles a small flag). Then, rapidly rotate the pencil while holding it still so that the notecard rotates around the pencil. As the notecard rotates, what three dimensional solid would be formed in the space that the notecard moves through?	This activity is meant to simulate rotating a rectangle (the notecard) about an axis (the pencil) to create a solid of revolution (in this case, a cylinder).
G.MG.A.1	Use geometric shapes to describe how to find the volume the water tower shown below could hold. 	
G.MG.A.2	An umbrella in the shape of a cone is open during a snowstorm. The umbrella has a base radius of 4 feet and a height of 1 foot. Snow accumulates on top of the umbrella evenly, to a depth of 5 inches and weighs 5 pounds. What is the volume of snow on top of the umbrella? (Remember that p=m/V, where p = density, m = mass, v = volume)	

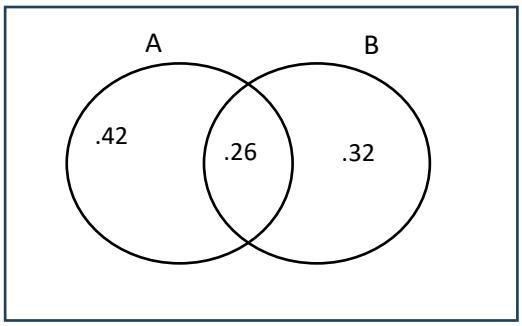
High School Geometry

Code	Sample Stem	Explanation
G.MG.A.3	Below is a model of a silo built to hold grain.  The silo's base has a diameter of 200 feet. The cylinder reaches a height of 150 feet before attaching to the half sphere top. In cubic feet, what is the volume of this silo and what would be its surface area?	
G.CP.A.1	A Venn diagram of events related to students at a high school is shown below.  Use the following characteristics of outcomes to describe each event. $A \cup B$ $A \cap B$ $(A \cup B)$	

High School Geometry

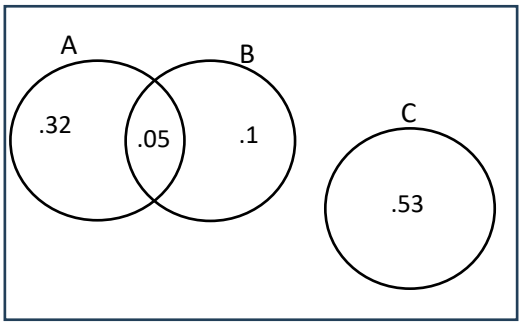
<table>
<tr><th>Code</th><th>Sample Stem</th><th>Explanation</th></tr>
<tr><td>G.CP.A.2</td><td>The table below shows some of the results of a survey given to 3rd and 4th grade students about their favorite ice cream flavors. The students were asked which flavor they preferred between strawberry and chocolate, and some of the numbers of students who preferred each are shown:

<table><tr><td></td><td>Strawberry</td><td>Chocolate</td><td>Total</td></tr><tr><td>3rd Grade</td><td></td><td>24</td><td></td></tr><tr><td>4th Grade</td><td>10</td><td>30</td><td>40</td></tr></table>
If a student’s grade level and ice cream preference are independent, how many 3rd grade students preferred strawberry ice cream?</td><td></td></tr>
<tr><td>G.CP.A.3</td><td>A Venn diagram of events A and B and their probabilities is shown below:

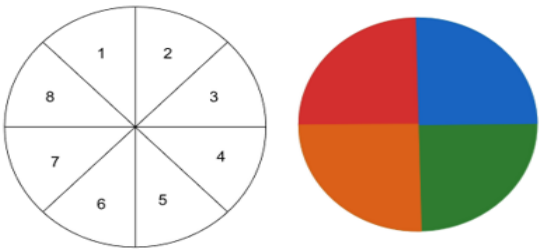
 
Find and interpret P(A|B)</td><td></td></tr>
<tr><td>G.CP.A.4</td><td>The table below shows some of the results of a survey given to 3rd and 4th grade students about their favorite ice cream flavors. The students were asked which flavor they preferred between strawberry and chocolate, and the numbers of students who preferred each are shown:

<table><tr><td></td><td>Strawberry</td><td>Chocolate</td><td>Total</td></tr><tr><td>3rd Grade</td><td>18</td><td>32</td><td>50</td></tr><tr><td>4th Grade</td><td>12</td><td>38</td><td>50</td></tr><tr><td>Total</td><td>30</td><td>70</td><td>100</td></tr></table>
If a randomly chosen student prefers chocolate ice cream, what is the probability that this student is in 3rd grade?</td><td>Students could also be provided with the survey results as a list (e.g., 18 3rd graders prefer strawberry, 32 3rd graders prefer chocolate, and so on) then have students construct a 2-way table before asking a similar question.</td></tr>
</table>

High School Geometry

Code	Sample Stem	Explanation
G.CP.A.5	A student is playing a game that involves them flipping a coin and then rolling a 6-sided die. Let A represent the event of the coin landing on heads and B represent the event of rolling a 6. Sarah concludes that A and B are independent events. What does this mean in context of events A and B? Raul concludes that $P(A\|B) = \frac{1}{6}$. What does this mean in context of events A and B?	
G.CP.A.6	An item is randomly selected from a basket of food. Let event A represent a fruit being selected, event B represent a red item being selected and event C represent a vegetable being selected. The sample space of these three events is shown below:  Find and interpret $P(A \text{ or } C)$ Find and interpret $P(A \text{ or } B)$	

High School Geometry

Code	Sample Stem	Explanation
G.CP.A.7	A student spins two spinners, one numbered 1-8 and another with four different colors. The spinners are shown below:  Let A be the event that a student spins an even number on the first spinner and B be the event that a student spins the color blue on the second spinner. Find and interpret $P(A \text{ and } B)$	
	A population of 1000 people undergo a genetic test for a particular gene. The test for the genetic marker has a 1% false negative rate (that is, if they test negative, there's a 1% chance they carry the gene) and a 6% false positive rate (if they test positive, there is a 6% chance they don't carry the gene). If 20% of the population of 1000 people test positive for the genetic marker, approximately how many people have the gene?	
G.CP.A.8	A class of 12th grade students has been chosen to help their school with the fall concert. In a class of 25 students, 3 will be randomly selected to form the committee. There are two ways being considered to make the committee. One way to form the committee is to have three roles: a planner, a treasurer, and a setup manager. How many different options are there for this committee? The other way to form the committee is for all three selected students to be titled "committee member" with no role identified. How many different options are there for this committee?	